Modeling Water and Nutrient Runoff from Nursery and Greenhouse Operations in Maryland

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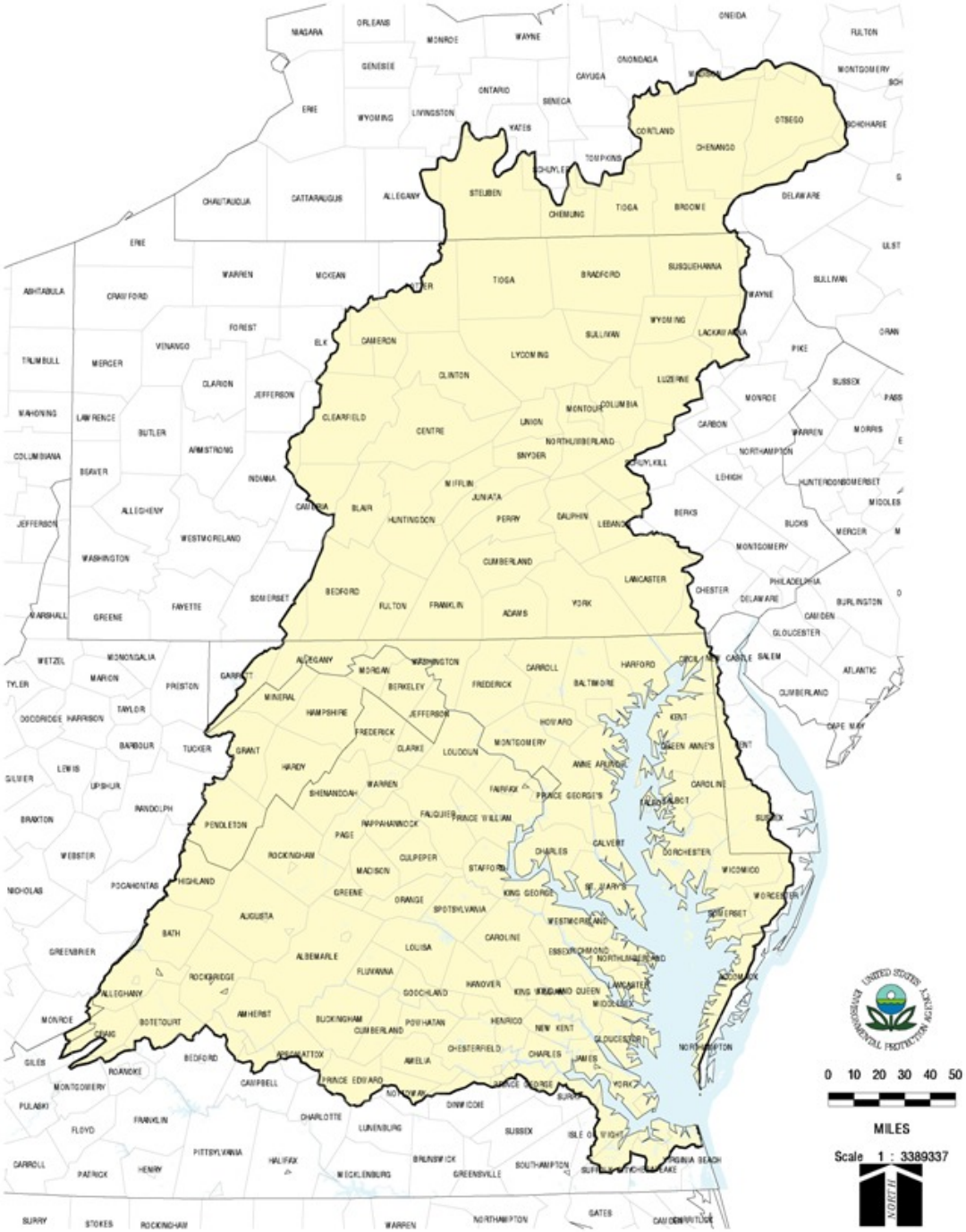
USDA-CSREES National Water Conference February 6 , 2008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MILES
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NORTH

Maryland Agriculture

- *1.28 million acres of harvested farmland in the state (2002)*
- *80,000 acres irrigated*
- *15,000 acres growing ornamental crops (nursery and greenhouse combined)*
- *Second only to poultry in gross income, but only uses 1% of farmland*

Chesapeake Bay Agreement

- 2010 goals (will not be met):
  - Define reductions for N, P, and sediment loading to achieve necessary water quality
    - N 285 million to 175 million pounds per year
    - P 19.1 million to 12.8 million pounds per year
    - Sediment 5.04 million to 4.15 million tons per year
  - Remove the bay and its tributaries from the impaired waters list

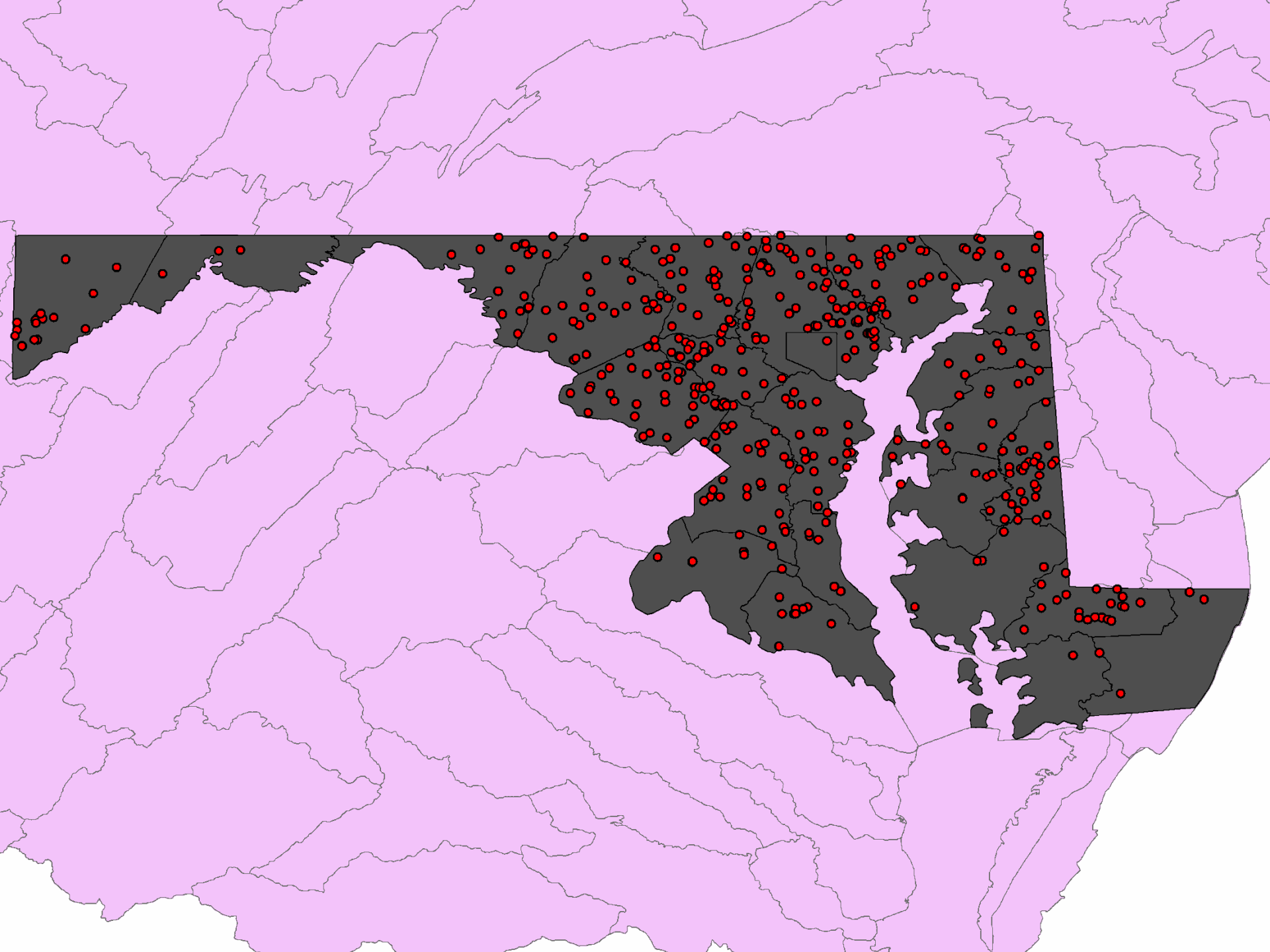
Research Objectives

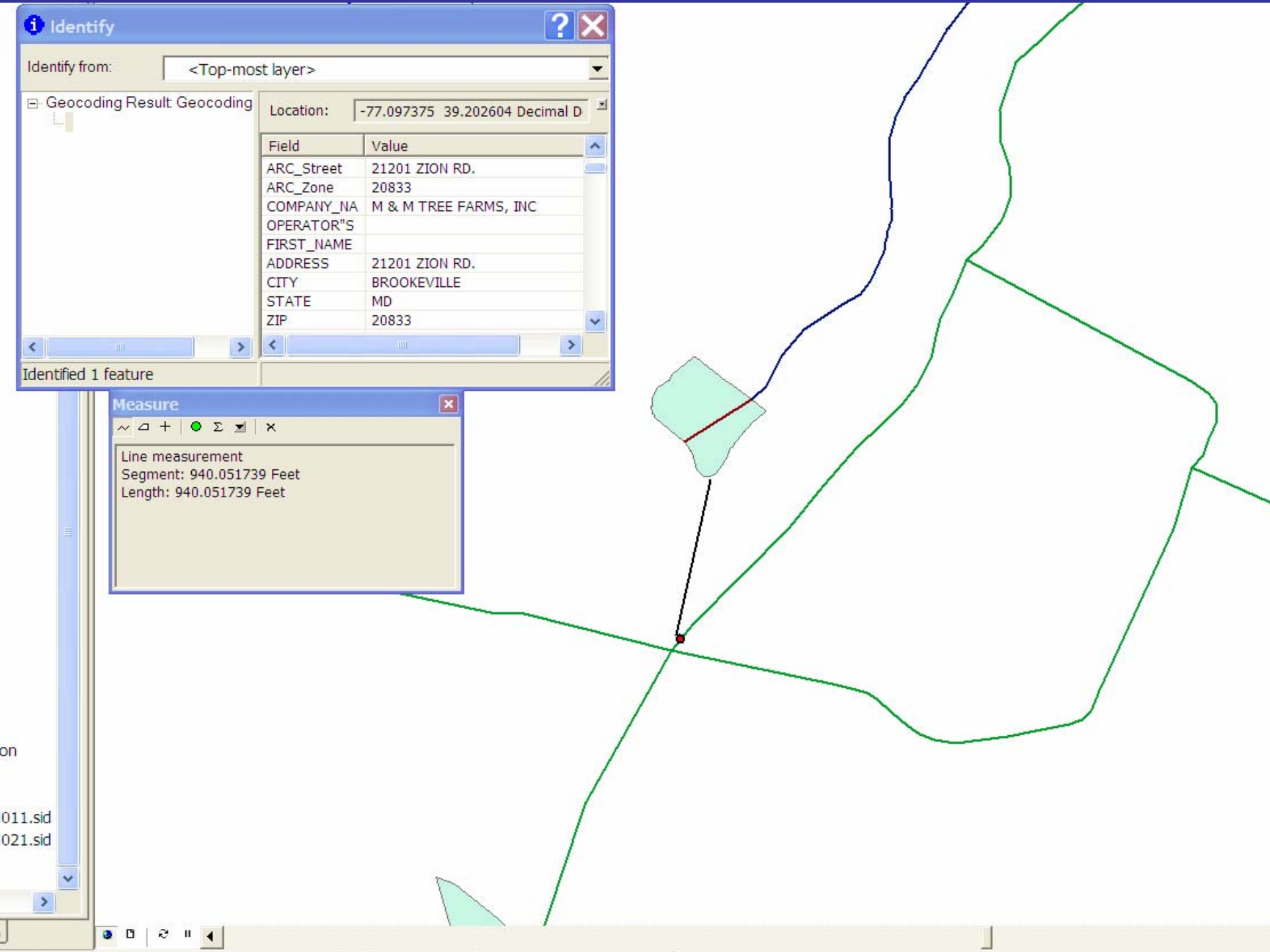
Phase I

Database creation (based on NMP and reports)

- Nursery information (size, type, production goals, water and nutrient strategies)
- Yearly fertilizer inputs by type
- Current Best Management Practices

- Determine total N and P inputs from N & G Operations and potential inputs into surface waters by type, watershed, operation size etc.
- Gain a statewide understanding of high priority watersheds (helpful for MDA etc.)
- Identify watersheds to focus on for phase II

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Field
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21201 ZION RD.
ARC_Zone
20833
COMPANY_NA
M & M TREE FARMS, INC
OPERATOR"S
FIRST_NAME
ADDRESS
21201 ZION RD.
CITY
BROOKEVILLE
STATE
MD
ZIP
20833
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Length: 940.051739 Feet
011.sid
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Phase II Model Design[1]

1. Define problem
2. Conceptual model
3. Select model type
4. Development
5. Computer implementation
6. Parameter estimation
7. Evaluation
8. Experimentation/Prediction

1 Turner, M.G., R.H. Gardner, and R.V. O'Neill. 2001. Landscape Ecology In Theory and Practice. Springer. United States.

Phase II

- Increase our understanding of current:
  - Practice (loading rates)
  - Management (to reduce loading)
  - Effects of mitigation structures (to reduce loading)
  - Operational efficiency (by type of operation)
- Better understanding of operational complexity
- Develop models for each production type
  - Field
  - Container
  - Greenhouse

Field Operations

- Extensive soil based systems
- Low nutrient and water applications
- Reduced nutrient runoff risk
- Sediment control is important

Container Operations

- Covered November-March
- Open April-October
- Higher N and P rates but CRF standard
- Potential risk for N and P runoff much more dependent on management and infrastructure (e.g. containment / recycling ponds)

Greenhouse Operations

- Covered structures (no runoff)
- High concentrations of soluble nutrients
- Precise water applications
- Potential for nutrient leaching
- Cost of fertilizer (increase efficiency / profit margin)

Greenhouse Example

	Operation 1	Operation 2
Container size	3.785 L	3.785 L
Nitrogen Conc.	100 ppm	200 ppm
Leaching Fraction	10%	20%
Water applied / day	0.5 Liter	0.5 Liter
N leached / day	5mg / day / container	20mg / day / container

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N leached / day	5mg / day / container	20mg / day / container
Total N leached per acre (80,000 containers)	**4 Kg (8.8 lb) N /acre / day**	**16 Kg (35.2 lb) N / acre / day**

Model Calibration and Testing

- Model values based on research literature and professional experience
- Run “what if” scenarios with high and low values
- Test models using published data
- Test our assumptions by interviewing growers (empirical data)
- Run sensitivity analyses to determine relative weight of different variables

Summary – Anticipated project outcomes

- Develop a geospatial database of all registered greenhouse and nursery operations in the state
- Determine yearly N and P usage by this industry, and estimate loading rates, by watershed and / or operation type
- Develop models for field, container, and greenhouse production including cost effectiveness of BMP's
- Develop models that can accurately represent the complexity in those systems (national scope)
- Analyze data for input into the Chesapeake Bay Model